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Developing Serious Video Games for Data Communication Courses

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Abstract

The development of educational games for data communication courses aims to help students understand data communication subject matter. The research method used in the development of educational games for the Data Communication course is Research and Development (R&D) with the DDD-E development model. The instruments used in the development of educational games are documentation and questionnaires. The research subjects consisted of 2 media experts, 2 material experts, 2 linguists and 30 potential users. The test results show that the educational games for the data communication course get good categories from media experts, material experts, and linguists, while the responses of potential users get very good categories..

Keywords: Video Games Education, Data Communication Course, Role-Playing Games, DDD-E

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INTRODUCTION

Data Communication is a compulsory subject at Information Technology and Computer Education Program (P.TIK) in IKIP PGRI Pontianak. Data communication emphasizes concepts related to sending and receiving data on computer devices through transmission media on a computer network (Forouzan, 2013). For this reason, students who take the Data Communication course are expected to be able to understand the principles of data communication on a network, types of transmission media, data to signal conversion, signal error detection and correction, switching, bandwidth utilization, and data path management.

Data Communication courses are a provision of initial knowledge for courses in the following semester, especially subjects related to computer networks and computer systems. According to research that has been conducted, good initial knowledge will help students achieve more optimal learning outcomes (Arifin, 2019; Astuti, 2015; Kalyuga, 2013; Lee, Donkers, Jarodzka, & van Merriënboer, 2019). Students with low initial knowledge will make it difficult for students to master skills in advanced courses, and vice versa if students have good initial knowledge, it will foster motivation in learning and better skills (Permana, Sabirin, & Feladi, 2016).

Seeing the importance of the Data Communication course as a knowledge base, it is important to ensure that students who take Data Communication courses achieve competencies in this course. To achieve the competencies that have been determined in the data communication course, lecturers who teach this course need to apply various learning strategies and methods (Nye, 2015).

Achieving Data Communication competency is a challenging job, because there are data communication concepts that are difficult to explain using a whiteboard or a module in text form (Latih, Hassan, & Ali, 2012). In addition, lecturers in the Data Communication course are not only required to explain the material, but also need to build an understanding of "how" and "why" the data communication process works (Gendron & Jarmoszko, 2003). The development of Information and Communication Technology (ICT) also encourages changes in communication materials that give rise to various terms that sometimes do not correspond to technological details (Bostan, 2015). Another obstacle in Data Communication lectures at P.TIK IKIP PGRI Pontianak is the change in curriculum which resulted in reduced credits for Data Communication courses which resulted in reduced study time for students.

Video games based learning media is one of the innovative solutions that can be chosen to overcome challenges and obstacles in the Data Communication course. Video game-based learning media can attract learning interest and motivation from students (Alamri, 2016; Cahyana, Paristiowati, Nurhadi, & Hasyrin, 2017; Saghir, 2014), and also promote the ability of students to learn independently (Nugraha, Florentinus, & Utomo, 2018). In addition to fostering a positive attitude in learning activities, video game-based learning media can also improve cognitive abilities, retain knowledge, and apply skills (Chen, Yeh, & Chang, 2016; Nurpratiwiningsih & Setiyoko, 2018; Zirawaga, Olusanya, & Maduki, 2017) .

Based on the description of the importance of data communication courses and the advantages of video games-based learning media, the purpose of this study is to develop video games-based learning media in accordance with the Data Communication course and to test the feasibility of the developed Data Communication video games.

METHODS

The method used in this research is the Research and Development (R&D) method using the DDD-E development model. The DDD-E development model is a linear development model consisting of four stages, namely Decide, Design, Development, and Evaluation. The first stage, namely Decide, is the planning stage of developing educational games for the Data Communication course, the activity at this stage is the analysis of content / material needs. The second stage, namely Design, is the stage of designing an educational game for the Data Communication course, the activities at this stage are compiling flowcharts and making storyboards. The third stage, namely Developement, is the stage of developing educational games for the Data Communication course, development is carried out based on the results of designing educational games using the RPG Maker MV application. The fourth or final stage, namely Evaluation, is the evaluation stage of the educational game for the Data Communication course that has been developed, the activity at this stage is to conduct a feasibility test for educational games by experts consisting of linguists, material experts, and media experts, besides testing try products by prospective users of educational games in the Data Communication course.

The subjects in the study consisted of development subjects and trial subjects. The development subjects consist of 2 (two) linguists, 2 (two) material experts for Data Communication courses, and 2 (two) media experts. The test subjects in this study were 30 (thirty) students of P.TIK IKIP PGRI Pontianak who took Data Communication courses.

The instruments used in this study were documentation and questionnaires. The documentation instrument was used at the decide, design, and developement stages, while the questionnaire instrument was used at the Evaluation stage. The document used in the decide stage is a Semester Learning Plan for the Data Communication course. The documents used at the design stage consist of flowchart documents and storyboards

documents. Documents used at the development stage are the results of educational game development. The questionnaire used in the evaluation stage was a questionnaire for material experts, linguists, media experts, and potential users. The grid from the material expert questionnaire, media expert, and media expert used in the research is based on a questionnaire developed by (Zunaidah & Amin, 2016) and adapted according to this research, while for student response questionnaires based on a questionnaire developed by (Sabirin, Sulistiyarini, & Zulkarnain, 2020) and adapted according to this research.

Table 1. Material Expert Instrument Guide

Aspect	Indicator
Subject Description	a. Completeness of material b. Breadth of material c. Depth of material
Accuracy	a. Basic Concepts of Data Communication b. Computer Network c. OSI Model d. Transmission medium e. Summary f. Exercise
Learning Support Materials	a. Conformity with the development of science and techology b. Curret features, examples and references c. Interrelationships between concepts d. Enrichment

Table 2. Media Expert Instrument Guide

Aspect	Indicator
Presentation Technique	a. Serving system b. Serving sequence
Serving Feasibility	a. Intro b. Material Explanation c. Practice
Graphic Feasibility	a. Initial view b. Menu and area c. Character and NPCs design d. Typography and visual effects e. Layout harmony

Table 3. Linguist Instrument Guide

Aspect	Indicator
Suitability with development of student	a. Conformity with the level of development of cognition b. Conformity with the level of social-emotional development
Communication	a. Readability b. Accuracy of Messages
Cluster and cohesiveness	a. Cluster and cohesiveness between materials b. Cluster and cohesiveness between conversation

Table 4. User Response Instrument Guide

Aspect	Indicator
Usability	a. Ease of use
	b. Game comprehension speed
	c. Game Satisfaction
Functionality	a. Delivery of material
	b. Battle
	c. Quest
	d. Exercise
Visual Communication	a. Character and NPCs design
	b. Menu and area
	c. Storyline

The results of assessments from media experts, linguists, material experts, and user responses will then be interpreted to see the feasibility of the educational games that have been developed. The interpretation of the assessment from experts and users can be seen in table 5 (Widoyoko, 2013).

Table 5. Interpretation of Questionnaire Results

Range	Interpretation
$X > 4{,}08$	Very Good
$3{,}36 < X \leq 4{,}08$	Good
$2{,}64 < X \leq 3{,}36$	Fairly Good
$1{,}92 < X \leq 2{,}64$	Poor
$X \leq 1{,}92$	Very Poor

RESULTS & DISCUSSION

Results

Development of Educational Games for Data Communication Courses begins with determining the topics to be used in the Educational Games and knowing the learning outcomes of each topic. The Data Communication course has ten topics, namely: 1) basic concepts of data communication; 2) computer network; 3) OSI model and TCP / IP protocol suite; 4) transmission medium; 5) Data and signals; 6) Digital transmission; 7) Bandwidth utilization; 8) Switching; 9) Error Detection and Correction; and 10) Data Link Control and Media Access Control. Of the ten topics in the Data Communication course, the Educational Games developed focus on the first four topics, namely the basic concepts of data communication, computer networks, OSI Model and TCP / IP protocol Suite, and transmission media. The learning outcomes on these topics can be seen in table 6.

Table 6. Learning Outcomes in Data Communication Course

Topics	Learning Outcomes
Basic Concepts of Data Communciaton	Students are able to know and explain data communication components, data types, and data flows
Computer Network	Students are able to know and explain the criteria for computer networks, types of computer networks, and computer network topologies
OSI Model and TCP/IP Protocol Suite	Students are able to know, explain, and differentiate between the OSI Model and the TCP / IP Protocol
Transmission Media	Students are able to know and explain wired and wireless transmission media

The next stage is designing an Educational Game which consists of making flowcharts, storyboards, and conversation scripts. The flowchart in the Educational Game developed is linear, which means that players must follow the storyline that has been compiled. Storyboards are arranged based on the topics to be made, where each topic is represented by a region / map. In each map there is a main quest which contains the main material of data communication, and an additional quest that contains additional material for the topic. The design description of this educational game can be seen in Figure 1.

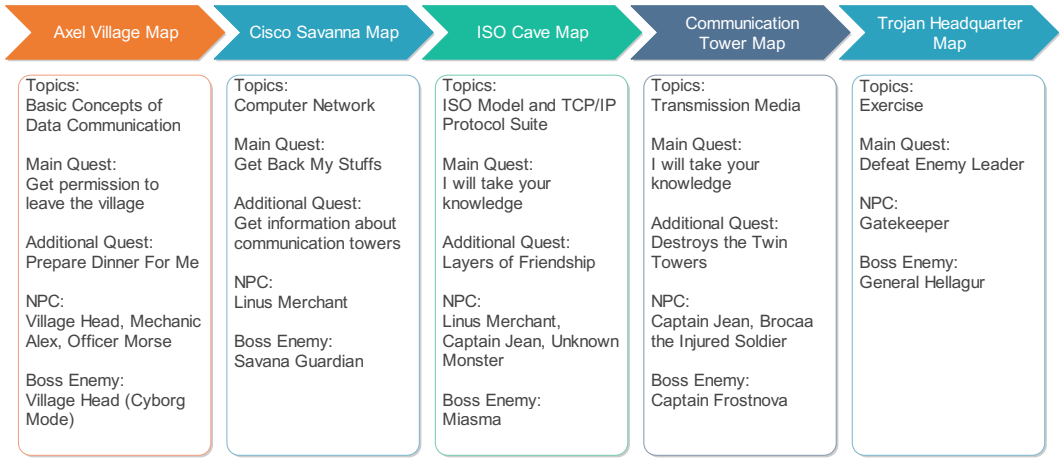

Figure 1. Game Design of Data Communication Course

Based on the results of the design that has been compiled, it is known that the educational game has five maps consisting of four maps used to convey material and one final map for evaluation. The first map is called Axel Village which is used to discuss the Data Communication Concept with the main quest being "Get Permission to Leave the Village" and the additional quest "Prepare Dinner for Me", there are three main NPCs in this map, and the last enemy on this map is the Head. Village. The second map is Savana Cisco which discusses the topic of computer networking, with the main quest being "Get Back My Stuffs" and an additional quest "Get Information About Communication Towers", there is one main NPC in this map, Merchant Linus, and the last enemy on this map is Savana keeper. The third map is the ISO Cave which discusses the topic of ISO Mode and the TCP / IP Protocol Suite with the main quest "I Will Take Your Knowledge" and an additional quest "Layers of Friendship", there are three NPCs on this map, Traders Linus, Captain Jean, and Monster Unknown, and the final enemy on this map is Miasma. The fourth map is a communication tower with the main quest being "Conquer the Transmission Tower" and an additional quest "" Destroys the Twin Towers ", there are two main NPCs, Captain Jean and Brocaa the Injured Soldier, and the last enemy on this map is Captain Frostnova. is the Trojan Headquarters used for evaluation, in this map there is one NPC, namely the Gebang Guard and the last enemy is General Hellagur.

The third stage is the development of educational games based on the designs that have been made. Educational game development uses the RPG Maker MV application which is an engine for making Role-Playing genre games. The first stage in developing this educational game is to create a map for each material. The results of developing a map for this educational game can be seen in Figure 2.

Figure 2. Map of Educational Games for Data Communication Courses

After the map is finished, the next step is to make an NPC for each map. NPCs function to provide materials to players through dialogue, questions, or quests. An example of delivering material from the NPCs can be seen in Figure 3.

Figure 3. Delivery of Data Communication Materials through Dialogue with NPCs

The next stage is to make enemies that the player must fight. The enemy in this educational game is used as an evaluation tool to measure the learning outcomes of data communication. The form of evaluation in this educational game is not like evaluation in general, the evaluation is carried out by the enemy by asking the player questions. If the

player can answer correctly, the player will be given an advantage, but on the other hand, if the player answers the question incorrectly, the enemy will get an advantage. An example of an evaluation in this game can be seen in Figure 4.

Figure 4. Evaluation of Learning through Battle with Enemy

The last stage in the development of educational games is to evaluate to see the quality of the educational games that have been developed. The evaluation of educational games was carried out by two material experts, two media experts, two linguists, and thirty potential users. The results of the educational game evaluation can be seen in table 7.

Table 7. Evaluation Results of Data Communication Educational Games

Aspek Penilaian	Skor	Keterangan
Material Experts		
Subject Description	3,42	Good
Accuracy	3,54	Good
Learning Support Materials	3,64	Good
Overall Assessment of Material Expert	**3,54**	**Good**
Media Experts		
Presentation Technique	4,20	Very Good
Serving Feasibility	4,12	Very Good
Graphic Feasibility	3,82	Good
Overall Assessment of Media Expert	**4,05**	**Good**
Linguist		
Suitability with development of student	3,52	Good
Communication	3,84	Good
Cluster and cohesiveness	3,60	Good
Overall Assessment of Linguists	**3,65**	**Good**
Prospective Users		
Usability	4,25	Very Good
Functionality	4,32	Very Good
Visual Communication	3,84	Good
Overall Assessment of Prospective Users	**4,13**	**Very Good**

Based on the results of the evaluation that has been done, it is known that the Data Communication educational game developed is in the good to very good category. According to material experts in general, educational games have been categorized as good, this can be seen from the aspects of the completeness of the description, the accuracy and

truth of the material, and learning supporting materials that have been categorized as good. According to media experts in general, educational games have been categorized as good, this can be seen from the assessment of the graphic aspects which are classified as good, even for the aspects of presentation techniques and presentation feasibility have been categorized as very good. According to linguists, in general, the educational games developed have been categorized as good, this can be seen from the aspect of suitability with the development of students, communicative, and coherence and cohesiveness which are classified as good. According to the assessment made by prospective users, the educational games developed are categorized as very good, this can be seen from the assessment of usability and functionality aspects which are in the good category, even though the visual communication aspect is still in the good category.

Discussion

The use of video games as a learning medium in the field of computer science is starting to be widely used (Krassmann, Falcane, Da Silva, & Medina, 2020). The use of video games as a learning medium is intended to help students understand materials in the computer field which tend to be complex (Zapušek & Rugelj, 2013). The development of educational games for data communication courses is also intended to assist students in learning data communication material so that the knowledge gained becomes long-term knowledge.

Educational video game development is of course different from conventional game development, in developing educational video games it is necessary to pay attention to two aspects, game aspect and learning aspect (Ashrafi-Rizi, Khorasgani, Zarmehr, & Kazempour, 2014). Educational game development is a special effort to achieve goals in the form of educational games using procedures that facilitate learning activities (Zirawaga et al., 2017). The use of too many aspects of the game will eliminate the meaning of education in educational games, and too much educational content will cause students to lose their motivation to learn. For this reason, it is necessary to have a balance between learning content and games in the development of educational games (Arias, 2014).

The balance in the Data Communication educational game that was developed is trying to be shown by maintaining the role-playing game (RPG) genre as an aspect of the game. RPG is a type of game that generally presents a fantasy or mystery story with clear rules and objectives. RPG allows players to control the process in the game being played. RPG is a type of game that tells a story in which the player has a certain role (Nugraha, Sumaryanto, & Utomo, 2019; Randi & Carvalho, 2013). RPG requires users to read the text as a narrative story of the game being played, players also need to do tasks to complete parts of the game to continue or end the game (Putra, 2014). To develop a game with the RPG genre, the engine used in this study is the RPG Maker MV. RPG Maker MV is an application that is used to create RPG-type games that have provided resources that can be used to develop games (Asriyatun & Nugroho, 2014; Wahyuni & Andiyoko, 2018). Even so, game developers can create their own resources for the games being developed.

In the Data Communication educational game that was developed, the materials were explained by the NPC through a narrative story by giving the players tasks that needed to be completed. In each map there is a main quest and an additional quest, the main quest is used to convey the main materials of data communication while the additional quest is used to convey additional material. To evaluate learning, this data communication educational game is carried out when fighting the enemies. When the player is about to fight the enemy, the enemy will ask the player several questions, if the player succeeds in answering the questions given, the player will get benefits such as adding status, getting items, getting skills, or getting a level increase, but if the player fails to answer the questions

given then enemies will get benefits such as increased status. Through evaluations like this, players will feel challenged to get the best results by reading the materials provided. This is in accordance with the research that has been done where the use of the term education in game development needs an adjustment to suit the type of game being developed (Topîrceanu, 2017).

The test results of the Data Communication educational game that have been developed are carried out by material experts, media experts, linguists and potential users. The test results from material experts and media experts show that the Data Communication educational game is in the good category. These results are in accordance with several studies that show that educational games are suitable for use as learning media (Amanda & Putri, 2019; Naimah, Winarni, & Widiyawati, 2019; Pratama & Haryanto, 2017). Unlike most other educational games, this Data Communication educational game is tested by linguists considering the number of conversations in the game, the test results from linguists show that the educational game is feasible to use. The last test was carried out by potential users who showed that the educational games developed were in the very good category, this result is in accordance with various studies which show that educational games can be received by users well or very well (Purnomo, Pratisto, Sahrul, & Lestari, 2016; Rachman, Purwanto, & Nugroho, 2019; Septiko, Akbar, & Afirianto, 2018).

CONCLUSION

Based on this research, it can be concluded that the learning media for Data Communication courses were developed in the form of educational games with the Role-Playing Games genre. Data Communication learning materials in the game are conveyed narrative by the NPC through a quest / task, and evaluation is carried out when fighting the enemy by asking questions before starting the fight which will give the player an advantage or a loss according to the ability to answer questions. The test results of the game show that the Data Communication educational game in media, material, and language is in a good category and the Data Communication educational game can be very well received by prospective users.

CONFLICT OF INTEREST

The researcher stated that the article entitled "Developing Serious Video Games for Data Communication Courses" has never been published and is not in the process of being published in another journal.

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